

REMARKS

This paper is responsive of an Office Action mailed on August 25, 2005. Prior to this response, claims 1-3, 5-13, 27, and 29 were pending. After amending claim 1, 8, 10, and 27, and canceling claim 13, claims 1-3, 5-12, 27, and 29 remain pending.

Claim 27 has been rejected under 35 U.S.C. 112, second paragraph, as being indefinite. In response, claim 27 has been amended to recite that the second metal gate electrode may have either a high work function or a low work function.

Claims 1-3, 5-13, and 27-28 have been rejected under 35 U.S.C. 103(a) as unpatentable with respect to Barnak et al. (“Barnak”; US Pub 2003/0146479), in view of Kiziliyalli et al. (“Kiziliyalli”; US 6,573,149). The Office Action states that Barnak [0030] describes the use of barrier layer that does not contribute to the work function of the gate electrode, and the use of a Cu interface layer overlying the gate electrode, but does not disclose all the gate materials of the claimed invention. The Office Action states that Kizilyalli describes some gate electrode materials and a barrier layer of less than 5 nm. The Office Action acknowledges that Kizilyalli discloses a dielectric barrier, but assets that this stated preference does not detract from the use of well known gate electrode materials. The Office Action states that one skilled in the art would be motivated to combine references to take advantage of Barnak’s teaching that a thin barrier layer may be used beneath a gate electrode without altering the work function. This rejection is traversed as follows.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As stated

in MPEP § 2143, there are three requirements to establish a *prima facie* case of obviousness.

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck* 947 F.2d 488, 20 USPQ2d, 1438 (Fed. Cir. 1991).

Generally, Barnak is concerned with replacing doped polysilicon as a gate electrode material. To that end Barnak discloses the use of a Ta (n-channel) and TaN (p-channel) gate electrodes [0033]. In one aspect, Barnak mentions that a Cu layer may be formed over the gate electrodes to avoid a silicide process. The use of Cu or silicide does not affect the gate electrode work function. In one embodiment, a thin barrier layer of either TiN or TaN can be used, which does not affect the work function [0034].

Kizilyalli discloses the use of Ta, W, Ti, TiN, and TaN, to replaces n-doped polycrystalline, and tungsten silicide to replace the use of p-doped polySi (col. 5, ln. 1-9). Kizilyalli also discloses the use of a high-k dielectric (metal etch barrier) 310 interposed between the gate electrode 410 and the gate dielectric 220. The metal etch barrier materials mentioned are tantalum pentoxide, silicon nitride, or aluminum oxide (col. 4, ln. 43-48).

With respect to claim 29 and the *first prima facie* requirement, the Office Action fails to provide any motivation to suggest that a person skilled in the art would have found it obvious to use WN as a first metal barrier layer. The fact the Kizilyalli discloses the use of W as a gate

electrode, has absolutely noting to do with the suitability of WN as a barrier material. WN has different properties than W, and it is being used for a different purpose. Alternately stated, that fact that a thick layer W has a work function useful as a gate electrode, would not necessarily suggest to an expert in the art that a thin layer of WN is useful as a barrier material. From the perspective of the second *prima facie* requirement, even if an expert were given the Kizilyalli and Barnak references as a foundation, no evidence has been provided that an expectation of success can be expected in a device that uses a WN barrier layer.

With respect to the third *prima facie* requirement, neither Barnak nor Kizilyalli explicitly disclose the use of a thin layer of WN that does not contribute to the work function in a gate stack with an overlying second metal. Since the combination of references neither explicitly discloses nor suggests all the elements of claim 29, the Applicant requests that the rejection be removed.

With respect to amended claims 1 and 27, even if the references are combined, the combination does not disclose all the limitations of the claimed invention. Specifically, the references do not explicitly disclose or suggest the use of Re, RuO₂, Pt, Hf, Zr, Cu, V, Ir, Ni, Mn, Co, NbO, Pd, Mo, TaSiN, Al, and Nb as a second metal, which is exclusively responsible for the gate electrode work function. Note: Barnak clearly states that he uses Cu to reduce sheet resistance, and that the treatments to reduce sheet resistance do not affect the gate electrode work function [0033]. Claims 2-3 and 5-12, dependent from claim enjoy the same distinctions from the cited prior art and Applicant requests that the rejection be removed.

It is believed that the application is in condition for allowance and reconsideration is earnestly solicited.

Respectfully submitted,

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